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Respiratory system
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Physiology

Overview

- Respiratory consists nose ,pharynx ,larynx ,trachea ,bronchii ,lung etc .
- The purpose of this system is to bring o2 into body and take co2 out of body .
- O2 is very essential for cell atp formation
- Glucose +o2 $\longrightarrow$ co2 +h2o +32 ATP
- This process is called as cellular respiration or aerobic respiration .above co2 is toxic for cell so it is removed from body .

- Otorhinolaryngology –the study of ENT .
- Pulmonology –study OF LUNG

Functional anatomy

- Nose
- Pharynx
- Larynx

upper respiratory tract

- Trachea
- Bronchii
- Lung alveolii

lower respiratory tract

NOSE

- Nose is divided into two major regions
- External nose- consists bony and cartilaginous parts
- Nasal cavity –space within the nose
- Surrounds by bones that are lined by mucosa
- Mucosa consists of an epithelial layer and underlying layer of connective tissue .
- Epithelial layer consists cilliated cells and scattered goblet cell
- Goblet cells are secrete mucosa
- Ant.region of nose –nostrils
- Post .region of nose –pharynx
- Sup .region of nose –olfactory epithelium which consists of sensory receptors that are involved in detection of smell .

Pharynx

- Also called throat
- A tube that join nose and mouth to the esophagus it is also part of GI tract
- Divided in three regions
- Nasopharynx
- Oropharynx
- Laryngopharynx
- The wall of pharynx consists 2 layers

  outer skeletal muscle

  inner mucosa

Larynx

- VOICE BOX
- Larynx consists three paired and three unpaired cartilage
- unpaired cartilages –thyroid carilage [adam's apple] it is larger in males than females b 'coz testosterone stimulates its growth during puberty .
- Cricoid cartilage a ring of cartilages present inferior to thyroid cartilages .
- Epiglottis spoon shaped cartilage that is attached to the thyroid cartilage one side and other side is free .
- Three paired cartilages I arytenoid
- 2 corniculate
- 3 cuniform

- 2 pairs of folds [which are string like connective tissue]
- 1 ..Vestibular folds not involved in vocalization
- 2 ..vocal folds involved in vocalization [sound production]

When air strickes the vocal folds ,the vocal folds vibrate and a sound is produced

Sound is depend on air strike

Male low pitch sound produce

Female high pitch sound produce

Skeltal muscle –middle layer of larynx

Mucosa inner layer of larynx

trachea

- Also called windpipe
- Consists of following components :
- cartilage :several c shaped rings of cartilage
- This rings prevent trachea from collapsing .
- Smooth muscle ; trachealis
- Mucosa :inneer layer

Bronchi

- The trachea give rise to the left primary bronchus ,which goes to left lung and the right primary bronchus which goes to right lung .
- Histological structure of each primary bronchus is similar to trachea .c shaped rings of cartilage form the outer anterior and lateral walls ,smooth muscle forms the outer posterior wall,and a mucosa lines the lumen .

Lungs

- There are two cone shaped lungs located in the thoracic cavity .
- Pleura –connective tissue sac surrounds each lung
- 2 layers –parietal and visceral
- Outer parietal fused with wall of thoracic cavity .
- Inner visceral attached to lung surface .
- pleural cavity –also called intrapleural cavity
- Potential space b'tn above two layer
- Its fluid is called intrapleural fluid
- It reduce the friction by lubricating .
- Right lung has 3 lobes ,while left lung has 2 lobes .

Internal organization –bronchial tree

- Primary bronchus
- Secondary lobar bronchi
- Tertiary [segmental]bronchi
- Bronchioles
- Terminal bronchioles
- Respiratory bronchioles
- Alveolar ducts
- Alveoli : typical clustered together like grapes to form
- Alveoli sac surrounded by extensive cappilary bed .
- At alveoli gas exchange occur

Alveolus : closer look

- 2 types of nonciliated epithelial cells
- Type 1 form wall of alveolus
- Type 2 also called septal cells –secrete surfactant which is chemical help to keep alveoli open
- Alveoli macrophagus present in alveoli this cells remove debris and microbes via phagocytosis

Define ventilation

- gases exchange b'n atmospheric air ,blood and tisuue cells called ventilation .
- Mechanism of ventilation
- Pulmonary ventilation –lung and atmosphere
- External respiration –alveoli and pulmonary capillaries
- Internal respiration –systemic capillaries and tissue cells

Pulmonary ventilation[breathing]

- Is a process by which air flows into and out of the lungs in order to undergo gas exchange in the alveoli
- Air flows b'n the atmosphere and lung based on a pressure gradient
- Air flows from atmosphere into lungs when the alveolar pressure is less than atmosphere
- Alveolar pressure is the pressure exerted on the wall of alveoli by gases in air within the lungs.
- Atmospheric pressure is the pressure exerted on our surroundings by gases in the air of atmosphere .
- At sea level atp p-760 mm hg
- Opposite in the expiration .

lung -Chest wall system

- Intraplural fluid causes the lungs and chest wall to be coupled together .so if thoracic cavity increases in size the lungs also expand .and ; and if TC decrease the lungs recoil .
- There are certain amount of pressure associated with the intrapleural fluid this pressure is called intrapleural pressure .
- Normally this pressure is subatmospheric ,ranging from 754 to 756 mm hg
- Intrapleural pressure is less than atp p it is said to be negative pressure [vacuum].

Breathing cycle

- Each breathing cycle consists 3 phases
- A period of rest
- An inspiration
- Expiration

Rest phase

- During this phase alveolar pressure is equal to atmospheric pressure ,which is 760 mmhg
- There for ,no air flows into or out of lung due to the lack of a pressure gradient .

Inspiration

- The flows of air into the lungs
- In order for to move into lungs ,alveolar pressure has to become less than atmospheric air
- This occurs by increasing the volume of the lungs
- Boyle's low –p ~ 1/v p –pressure
  v –volume

Mechanism-

Normal inspiration the diaphragm and external intercostal muscle contract .contraction of diaphragm cause muscle drop from arched position and contraction of external intercostal muscle cause pulls the ribs case upward .action of muscle have net effect of increasing the volume of the thoracic cavity .thoracic cavity enlarges ,the lung also expands .

Due to in.of thoracic cavity the pressure of alveolar decreases from 760 mmhg to 758 mmhg . In laboured inspiration other muscle also play imp role like sternocleidomastoid ,pectolaris minor ,scalenes .

Expiration

- The flow of air out of the lung
- Presssure in this condition 762 mmhg
- Laboured expiration is caused by the contraction of the internal intercostals and abdominal muscle [rectus abdominalis ,transversus abdominis ,external oblique ,and internal oblique .this muscles contraction pull the TC downward .

Neural and chemical control of respiration

- Basic rhythm of respiration is controlled by some part of medulla oblongata and pons .
- Respiratory centre : four respiratory centers
- 1 .dorasal respiratory group of neurons [DRGN]
- 2 .ventral respiratory group of neurons [VRGN]
- Apneustic centre –lower pons
- Pneumolaxic centre –upper pons
- 1 .DRGN –this is main centre which controls the respiration .they produce action potential .centre is connected to spinal cord ,phrenic nerves ,inter costal nerves and to inspiratory muscle .
- 2.VRGN – centre is connected to expiratory muscles like abdominal and internal inter costal muscle .it is inactive during quiet respiration .it is responsible for motor control of inspiratory and expiratory muscle during exercise .

- Pneumotaxic centre it is connected to inspiratory and apneustic centre .upper pons it sends message to DRGN to stop inspiration ,so that expiration can take place .
- Apneustic centre –lower pons it causes deep inspiration when pneumotaxic centre is damaged ,apneusis[DAMAGE PNEUMOTAXIC] occurs [DEEP INSPIRATION] as apneustic centre is free to act in absence of pneumotaxic centre .

CHEMICAL CONTROL

- TWO TYPES OF CHEMORECEPTORS : 1..central and 2..periphery
  central ARE SITUATED IN MEDULLA OBLONGATA
- AND periphery in aortic body and carotid body .

excess co2 and h2 ions in the blood mainly act directly on the repiratory centre. Both stimulated by excess of co2 and h2.

Artificial respiration

- Artificial respiration is useful in various accidents like drowning or electric shock .
- 1.. mouth to mouth very easy & success ful method
- 2 .. Sharpey schafer's method
- 3.. Marshall hall method
- 4 ..mechanical method

Asphyxia and hypoxia

- Hypoxia –a condition in which the oxygen avaible is inadequate at the tissue level
- Five type –anemic
- Hypoxemic
- Histotoxic
- Circulatory
- Hypermetabolic

Asphyxia

- A condition in which the body is deprived of oxygen
- Classification –suffocation
- Smothering
- Choking
- Strangulation
- Hanging dwowning
- Crush [traumatic]

Introduction of pulmonary function tests

- The amount of air that flows into or out of lungs can be measured by an apparatus called spirometer .
- A spirometer consists of a breathing tube ,a floating bell [which is cyndrical device floats in water]and pen recorder .
- Spirometer is used following way
- Patients breaths into the breathing tube
- The floating bell moves up and down in the water as the patient inhales and exhale .changes in the position of the floating bell reflect change in lung volume .
- A pen recorder then graph the changes in lung volume on a chart called spirogram .

4 types of lung volumes

- Tidal volume -500 the amount of air inhaled and exhaled during normal breathing cycle .
- Inspiratory reserve volume –maximum air inspired after normal breathing 3100ml in men and 1900 In women
- Expiratory reserve volume –maximum air expired after normal breathing 1200 In men and 700in women .
- Residual volume –the amount of air that remains in the lungs after a maximum expiration 1200 ml men and 1100 ml in women can't determined by spirometer .

Lungs capicity

-There are 4 types of lung capacities (Figure 23.16, Tortora):
-The term capacity refers to combinations of the various lungs volu

1. **functional residual capacity (FRC)**
   -the amount of air in the lungs at the end of a normal expi
   -the sum of the ERV and the RV
   -equals 2400 mL in men and 1800 mL in women
   -cannot be determined using a spirometer

2. **inspiratory capacity (IC)**
   -the maximum amount of air that can be inspired after a n
   expiration
   -the sum of the V_T and IRV
   -equals 3600 mL in men and 2400 mL in women

3. **vital capacity (VC)**
   -the maximum volume of air that can be inspired after a m
   expiration
   -the sum of the ERV, V_T, and IRV
   -equals 4800 mL in men and 3100 mL in women

4. **total lung capacity (TLC)**
   -the total amount of air in the lungs after a maximum inspi
   -the sum of all lung volumes
   -equals 6000 mL in men and 4200 mL in women

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